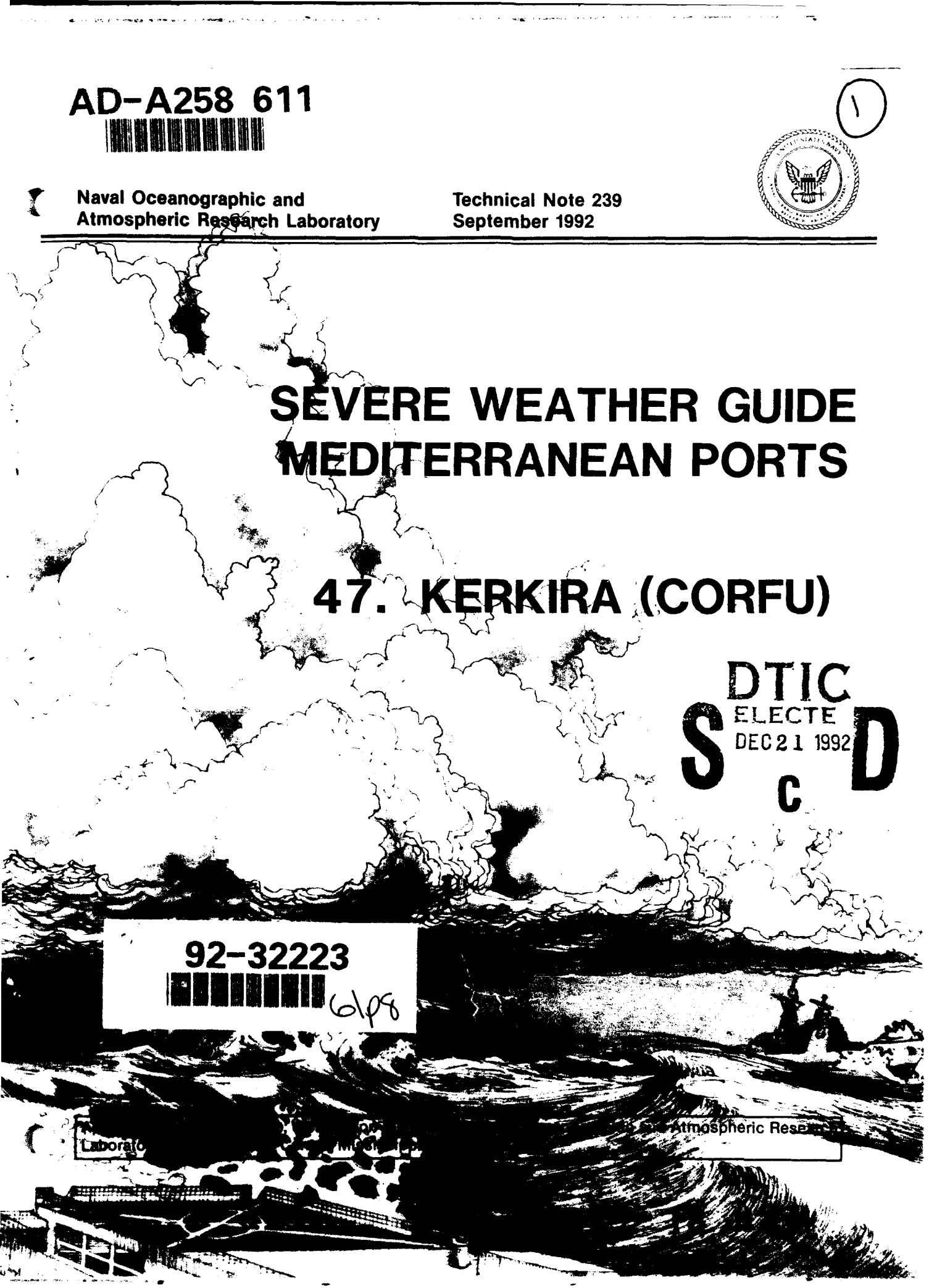
Naval Oceanographic and
Atmospheric Research Laboratory

Technical Note 239
September 1992

SEVERE WEATHER GUIDE MEDITERRANEAN PORTS

47. KERKIRA (CORFU)



These working papers were prepared for the timely dissemination of information; this document does not represent the official position of NOARL.

ABSTRACT

This handbook for the port of Kerkira (Corfu), one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.

ACKNOWLEDGMENTS

The support of the sponsor, Naval Oceanography Command, Stennis Space Center, MS, LCDR E. Steiner, USN, Program Element O&M,N-1, is gratefully acknowledged.

CONTENTS

FOREWORD

This handbook on Mediterranean Ports was developed as part of an ongoing effort at the Meteorology Division, Naval Research Laboratory (NRL), Monterey, to create products for direct application to Fleet Operations. The research was conducted in response to Commander Naval Oceanography Command (COMNAVOCEANCOM) requirements validated by the Chief of Naval Operations (OP-096).

As mentioned in the preface, the Mediterranean region is unique in that several areas exist where local winds can cause dangerous operating conditions. This handbook will provide the ship's captain with assistance in making decisions regarding the disposition of his ship when heavy winds and seas are encountered or forecast at various port locations.

Readers are urged to submit comments, suggestions for changes, deletions and/or additions to Naval Oceanography Command Center (NAVOCEANCOMCEN), Rota with a copy to the oceanographer, COMSIXTHFLT. They will then be passed on to NRL Monterey for review and incorporation as appropriate. This document will be a dynamic one, changing and improving as more and better information is obtained.

PORT INDEX

The following is a list of Mediterranean Ports that have been evaluated since 1988, with future ports and probable year of distribution also included. Computerized versions of these port guides are currently available for those ports with an asterisk (*). Those without the asterisk will be computerized in the near future. Contact the Naval Research Laboratory (NRL), Monterey or NOCC Rota for IBM compatible floppy disk copies.

NO.	PORT
*1	GAETA, ITALY
*2	NAPLES, ITALY
*3	CATANIA, ITALY
*4	AUGUSTA BAY, ITALY
*5	CAGLIARI, ITALY
*6	LA MADDALENA, ITALY
7	MARSEILLE, FRANCE
8	TOULON, FRANCE
9	VILLEFRANCHE, FRANCE
10	MALAGA, SPAIN
11	NICE, FRANCE
12	CANNES, FRANCE
13	MONACO
14	ASHDOD, ISRAEL
15	HAIFA, ISRAEL
16	BARCELONA, SPAIN
17	PALMA, SPAIN
18	IBIZA, SPAIN
19	POLLENSA BAY, SPAIN
20	LIVORNO, ITALY
21	LA SPEZIA, ITALY
22	VENICE, ITALY
23	TRIESTE, ITALY
*24	CARTAGENA, SPAIN
*25	VALENCIA, SPAIN
*26	SAN REMO, ITALY
*27	GENOA, ITALY
*28	PORTO TORRES, ITALY
*29	PALERMO, ITALY
*30	MESSINA, ITALY
*31	TAORMINA, ITALY
*32	TARANTO, ITALY
*33	TANGIER, MOROCCO
*34	BENIDORM, SPAIN
*35	ROTA, SPAIN
*36	LIMASSOL, CYPRUS
*37	LARNACA, CYPRUS
*38	ALEXANDRIA, EGYPT
*39	PORT SAID, EGYPT
*40	BIZERTE, TUNISIA
*41	TUNIS, TUNISIA
*42	SOUSSE, TUNISIA
*43	SFAX, TUNISIA
*44	SOUDA BAY, CRETE
*45	PIRAEUS, GREECE
*46	KALAMATA, GREECE
*47	KERKIRA (CORFU), GREECE
*48	KITHIRA, GREECE
*49	THESSALONIKI, GREECE

1993	PORT
	VALLETTA, MALTA
	ISKENDERUN, TURKEY
	IZMIR, TURKEY
	ISTANBUL, TURKEY
	ANTALYA, TURKEY

PREFACE

Environmental phenomena such as strong winds, high waves, restrictions to visibility and thunderstorms can be hazardous to critical Fleet operations. The cause and effect of several of these phenomena are unique to the Mediterranean region and some prior knowledge of their characteristics would be helpful to ship's captains. The intent of this publication is to provide guidance to the captains for assistance in decision making.

The Mediterranean Sea region is an area where complicated topographical features influence weather patterns. Katabatic winds will flow through restricted mountain gaps or valleys and, as a result of the venturi effect, strengthen to storm intensity in a short period of time. As these winds exit and flow over port regions and coastal areas, anchored ships with large 'sail areas' may be blown aground. Also, hazardous sea state conditions are created, posing a danger for small boats ferrying personnel to and from port. At the same time, adjacent areas may be relatively calm. A glance at current weather charts may not always reveal the causes for these local effects which vary drastically from point to point.

Because of the irregular coast line and numerous islands in the Mediterranean, swell can be refracted around such barriers and come from directions which vary greatly with the wind. Anchored ships may experience winds and seas from one direction and swell from a different direction. These conditions can be extremely hazardous for tendered vessels. Moderate to heavy swell may also propagate outward in advance of a storm resulting in uncomfortable and sometimes dangerous conditions, especially during tending, refueling and boating operations.

This handbook addresses the various weather conditions, their local cause and effect and suggests some evasive action to be taken if necessary. Most of the major ports in the Mediterranean will be covered in this series of handbooks. A priority list, established by the Sixth Fleet, exists for the port studies conducted and this list will be followed as closely as possible in terms of scheduling publications.

RECORD OF CHANGES

CHANGE NUMBER	DATE OF CHANGE	DATE ENTERED	PAGE NUMBER	ENTERED BY

1. GENERAL GUIDANCE

1.1 DESIGN

This handbook is designed to provide ship captains with a ready reference on hazardous weather and wave conditions in selected Mediterranean harbors. Section 2, the captain's summary, is an abbreviated version of section 3, the general information section intended for staff planners and meteorologists. Once section 3 has been read, it is not necessary to read section 2.

1.1.1 Objectives

The basic objective is to provide ship captains with a concise reference of hazards to ship activities that are caused by environmental conditions in various Mediterranean harbors, and to offer suggestions for precautionary and/or evasive actions. A secondary objective is to provide adequate background information on such hazards so that operational forecasters, or other interested parties, can quickly gain the local knowledge that is necessary to ensure high quality forecasts.

1.1.2 Approach

Information on harbor conditions and hazards was accumulated in the following manner:

A. A literature search for reference material was performed.
B. Cruise reports were reviewed.
C. Navy personnel with current or previous area experience were interviewed.
D. A preliminary report was developed which included questions on variou local conditions in specific harbors.
E. Port/harbor visits were made by NOARL personnel; considerable information was obtained through interviews with local pilots, tug masters, etc; and local reference material was obtained.
F. The cumulative information was reviewed, combined, and condensed for harbor studies.

1.1.3 Organization

The handbook contains two sections for each harbor. The first section summarizes harbor conditions and is intended for use as a quick reference by ship captains, navigators, inport/at sea OOD's, and other interested personnel. This section contains:

A. a brief narrative summary of environmental hazards,
B. a table display of vessel location/situation, potential environmental hazard, effect-precautionary/evasion actions, and advance indicators of potential environmental hazards,
C. local wind wave conditions, and
D. tables depicting the wave conditions resulting from propagation of deep water swell into the harbor.

The swell propagation information includes percent occurrence, average duration, and the period of maximum wave energy within height ranges of greater than 3.3 feet and greater than 6.6 feet. The details on the generation of sea and swell information are provided in Appendix A.

The second section contains additional details and background information on seasonal hazardous conditions. This section is directed to personnel who have a need for additional insights on environmental hazards and related weather events.

1.2 CONTENTS OF SPECIFIC HARBOR STUDIES

This handbook specifically addresses potential wind and wave related hazards to ships operating in various Mediterranean ports utilized by the U.S. Navy. It does not contain general purpose climatology and/or comprehensive forecast rules for weather conditions of a more benign nature.

The contents are intended for use in both pre-visit planning and in situ problem solving by either mariners or environmentalists. Potential haz-

ards related to both weather and waves are addressed. The oceanographic information includes some rather unique information relating to deep water swell propagating into harbor shallow water areas.

Emphasis is placed on the hazards related to wind, wind waves, and the propagation of deep water swell into the harbor areas. Various vessel locations/situations are considered, including moored, nesting, anchored, arriving/departing, and small boat operations. The potential problems and suggested precautionary/evasive actions for various combinations of environmental threats and vessel location/situation are provided. Local indicators of environmental hazards and possible evasion techniques are summarized for various scenarios.

CAUTIONARY NOTE: In September 1985 Hurricane Gloria raked the Norfolk, VA area while several US Navy ships were anchored on the muddy bottom of Chesapeake Bay. One important fact was revealed during this incident: Most all ships frigate size and larger dragged anchor, some more than others, in winds of over 50 knots. As winds and waves increased, ships 'fell into' the wave troughs, BROADSIDE TO THE WIND and became difficult or impossible to control.

This was a rare instance in which several ships of recent design were exposed to the same storm and much effort was put into the documentation of lessons learned. Chief among these was the suggestion to evade at sea rather than remain anchored at port whenever winds of such intensity are forecast.

2. CAPTAIN'S SUMMARY

The Port of Kerkira (Corfu), on the Island of Kerkira, is located in the northeastern Ionian Sea just off the northwest coast of Greece near 39°37' N, 19°56'E (Figure 2-1) (FICEURLANT, 1987).

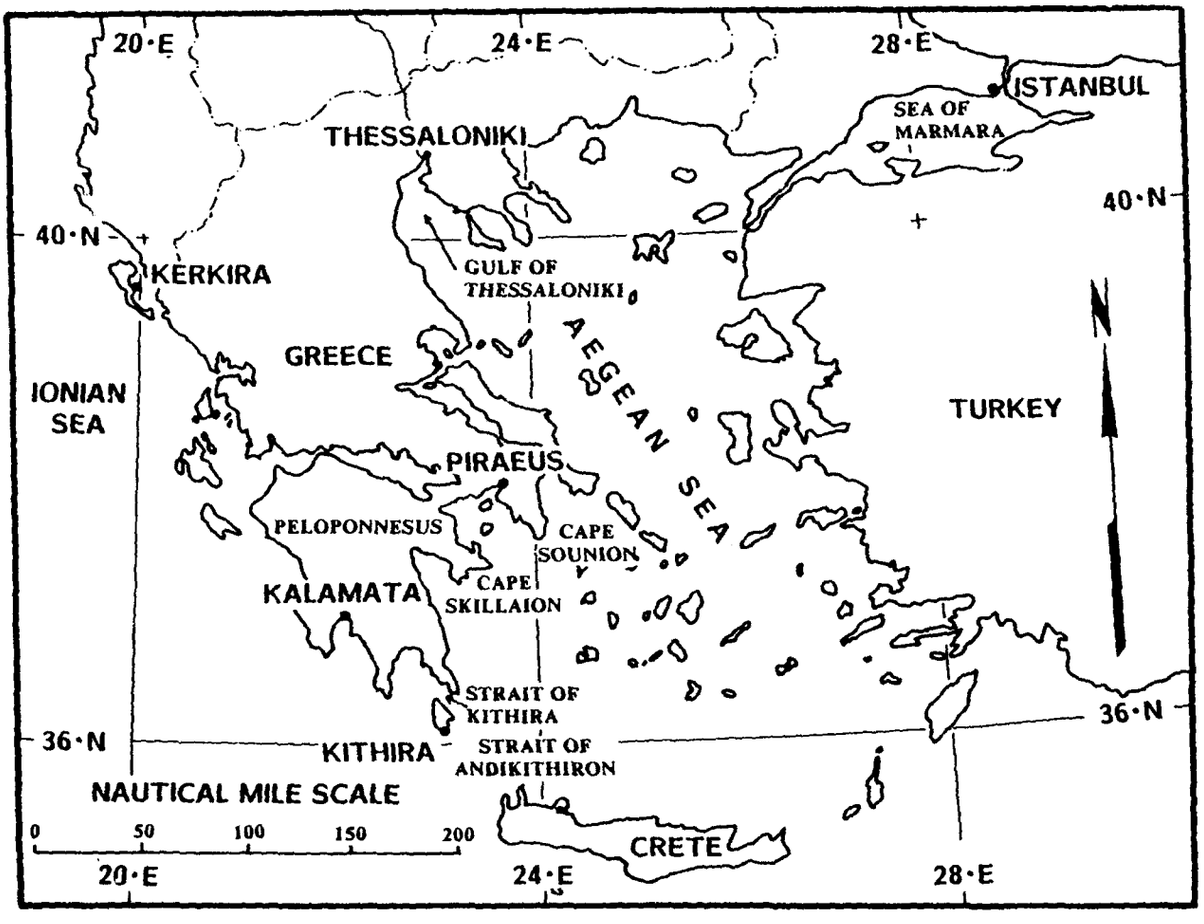


Figure 2-1. Ports of Greece and Surrounding Waters.

The Port is situated on the eastern side of Kerkira Island just slightly north of the center of the north-south extent of the Island (Figure 2-2). Kerkira Island is about 36 miles long and, at its widest portion near the northern end, about 17 miles wide (FICEURLANT 1987). The island terrain is composed of hills or low mountains with maximum elevations ranging from near 600 ft in the south portion to a maximum of 2989 ft in the northeast sector. The mainland terrain is mountainous with elevations over 4000 ft within a few miles of the coast. The Corfu Channel separates the Island from the mainland to the east. The Channel width varies from about 1 n mi at its northern entrance to about 12 n mi at its widest point in the vicinity of the Port. The southern entrance is about 4 n mi wide. Open channel depths range from a minimum of about 26 fathoms in the northern entrance area to greater than 30 fathoms elsewhere.

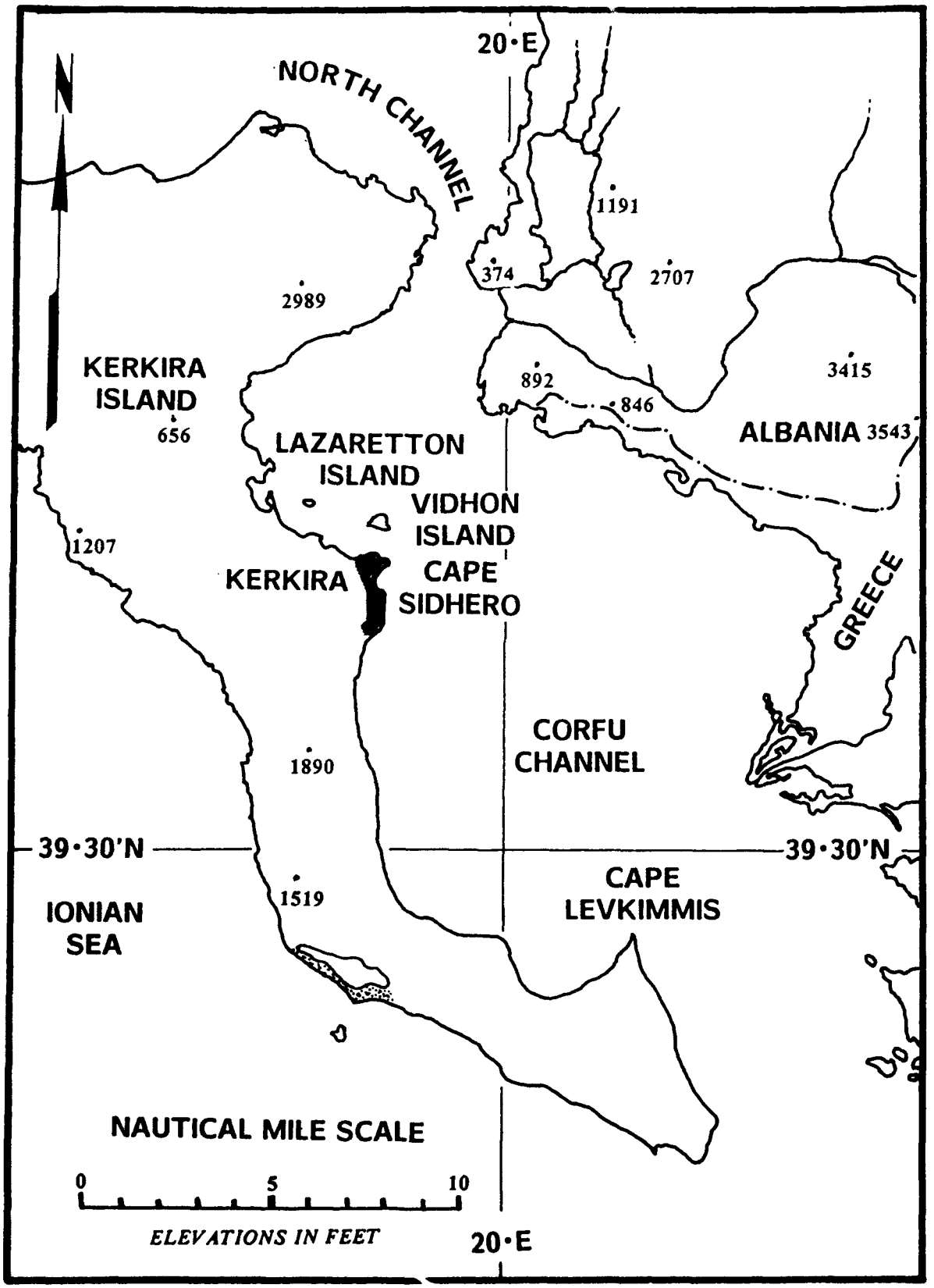


Figure 2-2. Approaches to the Port of Kerkira (Corfu), Greece.

The Port of Kerkira (Corfu) is located on the north side of Cape Sidhero (Akra Sidhero) (Figure 2-3). A small island (Nisis Vidhon) is located about 1/2 n mi offshore north of the Port and a smaller island (Nisis Lazaretton) is located about 2 n mi to the northwest of the Port. A number of rocks and shoals exist between and around the two islands. The Port is entered from the east via the roadstead between Cape Sidhero and Vidhon Island. The city of Kerkira extends across the Cape and along both the north and east facing coastlines. The Port facilities are located along the north facing coast.

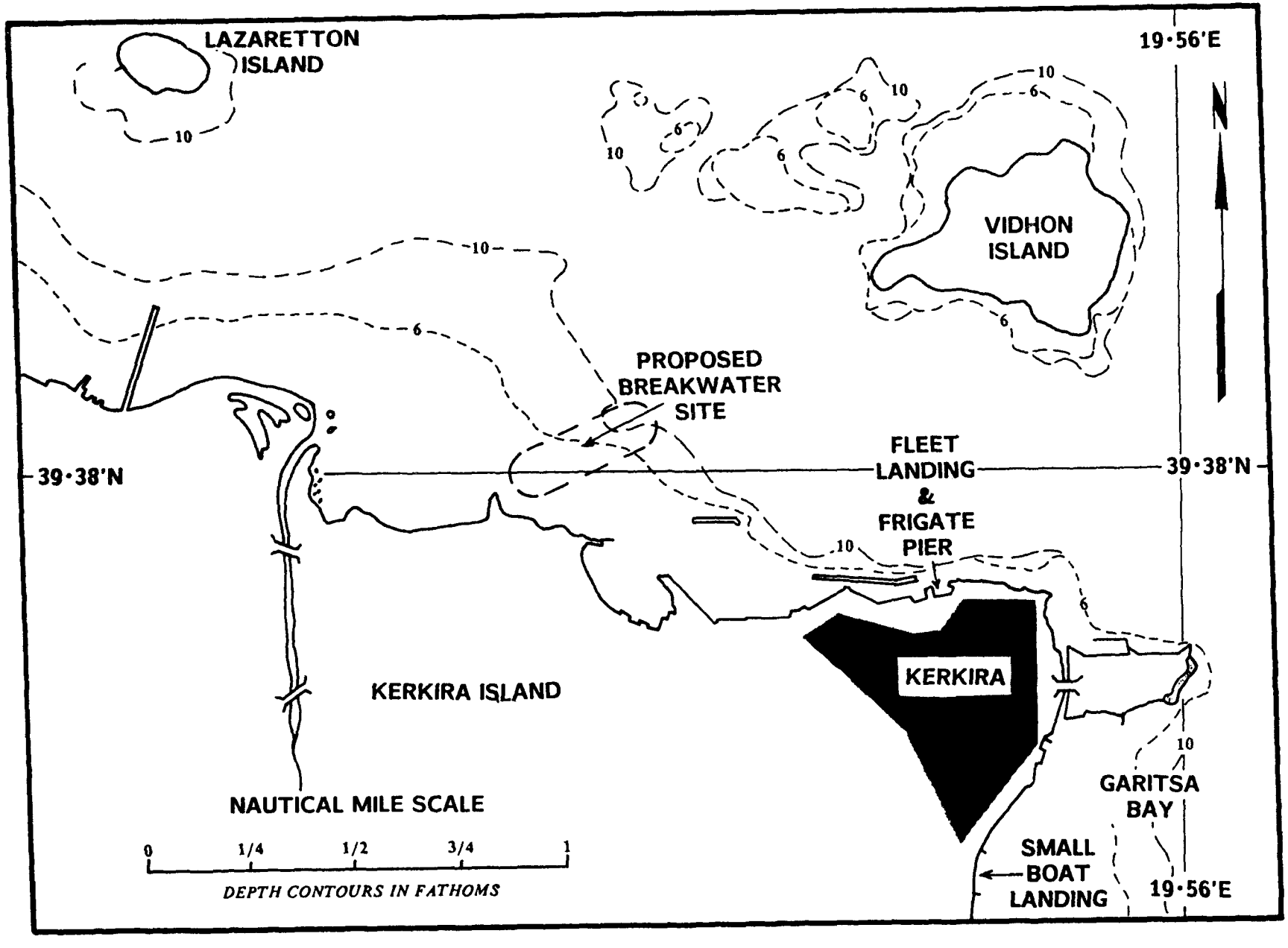


Figure 2-3. The Port of Kerkira (Corfu), Greece.

The Port has no berthing for large ships. A 240-ft quay (26 ft alongside depth) located in the eastern portion of the Port, and an inner harbor formed by a detached breakwater that extends about 2100 ft westward from the quay area comprise the mooring and docking facilities. Small ships can moor stern on to the breakwater (FICEURLANT, 1987) but depths are not stated. A second detached breakwater is located to the west of the first one with a third planned by 1992 yet further to the west.

Anchorage can be made between the harbor and Vidhon Island at depths of approximately 98 ft (39 m) with a stiff mud and clay bottom. Carriers typically anchor eastward of a north-south line from Cape Sidhero to Vidhon Island in 130 to 140 ft depths. This area has a mud bottom which provides poor holding. Caution was advised (Port Visit, 1990) relative to anchor dragging when southerly winds of 22 to 33 kt or greater are expected. Secondary anchorages are located south of Cape Sidhero and north-northwest of Lazaretton Island. The anchorage south of Cape Sidhero in, and offshore from, Garitsa Bay provides protection from strong north-northwest winds. Depths are in excess of 66 ft (20 m) at about 1/2 n mi offshore. The anchorage north-northwest of Lazaretton Island provides protection from the strong southerly winds occasionally experienced during winter. Depths range from 60 to 95 ft (18 to 29 m).

The roadstead between the north facing shore and Vidhon Island is exposed to both the prevailing summer northwesterlies and the winter southeasterlies (Hydrographer of the Navy, 1970). Wind speeds, however, are not particularly high. Two to three times a winter south to southeast 22 to 33 kt (force 6-7) winds, with rare occurrences of 34 to 40 kt (force 8), can be expected. During strong southerly wind events waves in the carrier anchorage area will reach 5-7 ft (2 m). During summer the prevailing north-northwest winds, locally called Meltemi, range from 11 to 33 kt. The strongest events, associated with larger

scale Etesians, typically last about three days and can result in 2 to 3 ft waves in the harbor area. The summer northerly winds are enhanced by the sea breeze from mid-day through evening and tend to drop off by 2200 LST. Strong northerlies also occur in winter and are associated with Boras and/or the northerly flow on the backside of cyclones tracking eastward, south of Kerkira. Note that all wind speed values are based on observations from land stations. Wind speeds over the open water are typically higher. Maximum speeds for southerly winds in the exposed carrier anchorage are likely to be near 41 to 47 kt (Force 9).

Visibility is usually 8 to 10 miles but may be reduced to near zero a couple of mornings a year during spring or summer due to fog. The fog typically burns off by 1000 LST. During winter, periods of rain, low clouds and strong southerly winds are experienced with frontal systems that approach from the west. These systems generally affect portions of Italy 12 to 24 hr before reaching Kerkira. During winter, when the circulation results in northerly winds flowing out of the land area of southeast Europe, near freezing morning temperatures will occur. Windchill can present a hazard.

Specific hazardous environmental conditions, vessel situations, and suggested precautionary/evasive action scenarios for the Port of Kerkira are summarized in Table 2-1.

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Table 2-1. Summary of Hazardous Environment

HAZARDOUS CONDITIONS	INDICATORS OF POTENTIAL HAZARD
1. <u>Strong wind from SE to S</u> - Generally referred to as "Scirocco", but most often caused by cyclogenesis in the Gulf of Genoa and associated fronts approaching from the west. * Most likely during November-February period. * Typical event has 30-40 kt winds with 45 to 50 kt maximum, waves 4 to 7 ft (1-2 m) * True Scirocco out of Africa, moist type with clouds and precipitation that may contain dust. Winds 22-33 kt. Most frequent in spring.	<u>Advance Warning</u> * Genoa low development followed by low tracking southeastward into Ionian Sea, or secondary low development occurring over Ionian Sea. * Low moves out of North Africa under 500 mb trough that extends from southern Europe into northern Africa, Scirocco conditions in warm sector of low. * Altocumulus clouds approaching from the south frequently observed day before onset of surface winds. <u>Duration</u> * Genoa low systems, about a day each for each low, but may have 2 to 3 low sequence. Onset generally gradual, most rapid onset and most intense systems occur with Ionian Sea cyclogenesis. * Scirocco conditions may persist for several days, onset is quite gradual over 1 to 2 days.

Environmental Conditions for the Port of Kerkira, Greece

D	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT-PRECAUTIONARY/EVASIVE ACTIONS
nt cking Ionian ow ng over	(1) Anchored in Roadstead.	a) The Port is well protected. * No vessel has ever been forced to sortie. * No grounding in last 40 years (1990).
rth trough outhern n Africa, in warm	(2) Carrier Anchorage.	a) Exposed to southerly wind and waves. * Protected anchorage area NNW of Lazaretton Island.
e south day race	(3) Small Boat Operations.	a) Hazardous conditions at carrier anchorage. * Fleet landing may be relocated to inside breakwater or to northern end of moat between town and the citadel.
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may days, ual over		

Table 2.1 conti

HAZARDOUS CONDITIONS	INDICATORS OF POTENTIAL HAZARD
2. Strong wind from NW to NE. - Winter events related to "Bora", summer events to "Etesian", known locally as "Meltemi". * "Boras" most frequent December-February, maximum winds NW-N'ly 34 to 40 kt; waves 3 to 5 ft (1-1½m). * Land breeze off snow covered mountains of mainland combine with weaker "Boras" resulting in maximum diurnal winds of NE'ly 15 to 25 kt during morning.	Advance Warning * Boras result from high pressure building eastward across Europe. There may be a concurrent low center moving eastward over the Mediterranean. As migratory low moves eastward of local area, most intense northerly winds experienced, coldest temperature likely a day or two later. * Meltemi (Etesians) intensity when the low pressure trough extending westward from Asia Minor to the southwestern coast of Turkey is most intense and extends the fartherst westward.. Increasing cloudiness develops over Balkan area the day before onset of strong events. Duration * Bora conditions may last for several days if low stalls over eastern Mediterranean or a sequence of lows pass eastward south of the local area, while high pressure is maintained over southeastern Europe. * Etesian conditions persist all summer, strong events may last for several days or even weeks.

le 2.1 continued

RD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT-PRECAUTIONARY/EVASIVE ACTIONS
qh stward e may be ter the igratory t local ortherly oldest day or ntensity e trough rom Asia stern ost the s area of last for stalls ranean s pass o local ssure is neastern ersist vents days or	(1) Anchored in Roadstead.	a) Exposed to NW'ly winds. * Alongside work hazardous. * Protected anchorages south of Cape Sidhero in Garitsa Bay. * If winds NE'ly, some protection in lee of Vidhon Island.
	(2) Carrier Anchorage.	a) Exposed to N'ly winds. * Protected anchorages south of Cape Sidhero in Garitsa Bay.
	(3) Small Boat Operations.	a) Harbor, Roadstead and Carrier Anchorage Exposed. * Fleet landing may be relocated to inside breakwater or Garitsa Bay. * Alongside operations and cargo handling may have to be halted.

SEASONAL SUMMARY OF HAZARDOUS WEATHER CONDITIONS

WINTER (November through February):

* S to SE wind (migratory cyclones) 22 to 33 kt, extreme 41 to 47 kt
  - waves 4 to 7 ft in Corfu Channel and carrier anchorage
  - duration 1 to 2 days, onset variable, approach variable
* NW wind (Boras) 22 to 33 kt, extremes 34 to 40 kt
  - waves 3 to 5 ft in harbor
  - duration 1 to 2 days, onset rapid, gradual weakening

SPRING (March through May)

* S to SE wind (Scirocco) 22 to 33 kt
  - waves 4 to 7 ft in Corfu Channel
  - duration several days, onset gradual
* Occasional fog, vsby near zero, generally clear by 1000

SUMMER (June through September)

* N'ly wind (Meltemi) 11 to 33 kt, enhanced by afternoon seabreeze
  - waves 2 to 3 ft in harbor
  - persists throughout season, strong events last 2 to 4 days
* Occasional fog, vsby near zero, generally clear by 1000

AUTUMN (October)

* Typical Mediterranean region rapid change to winter weather
  - expect first winter-type cyclone by end of month

NOTE: For more detailed information on hazardous weather conditions, see previous Table 2-1 in this section and Hazardous Weather Summary in Section 3.

References

FICEURLANT, 1987: Port Directory for Kerkira (Corfu), Greece. Fleet Intelligence Center Europe and Atlantic, Norfolk, VA.

Hydrographer of the Navy, 1970: Mediterranean Pilot. Volume III. Hydrographer of the Navy, London, England.

PORT VISIT INFORMATION

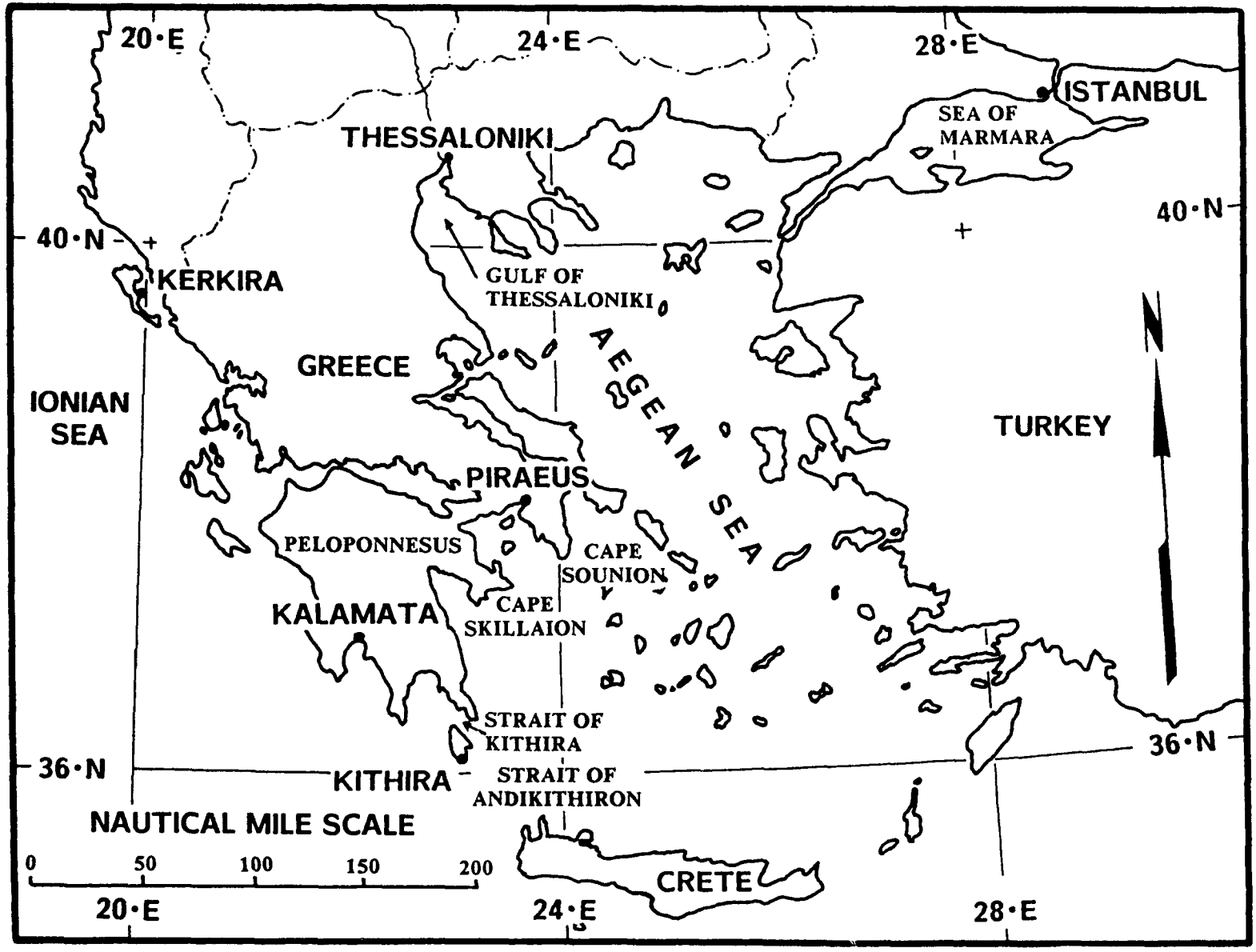
May 1990: NOARL Meteorologists R. Fett and R. Miller met with the Harbor Master, Senior Commander S. Lomas and Lieutenant Commander M. Vlachos, to obtain much of the information included in this port evaluation.

3. GENERAL INFORMATION

This section is intended for Fleet meteorologists/ oceanographers and staff planners. Section 3.5 includes a general discussion of hazards and Table 3-2 provides a summary of vessel locations/situations, potential hazards, effect-precautionary/evasive actions, and advance indicators and other information by season.

3.1 Geographic Location

The Port of Kerkira (Corfu), on the Island of Kerkira, is located in the northeastern Ionian Sea just off the northwest coast of Greece near 39° 37'N, 19° 56'E (Figure 3-1) (FICEURLANT, 1987).



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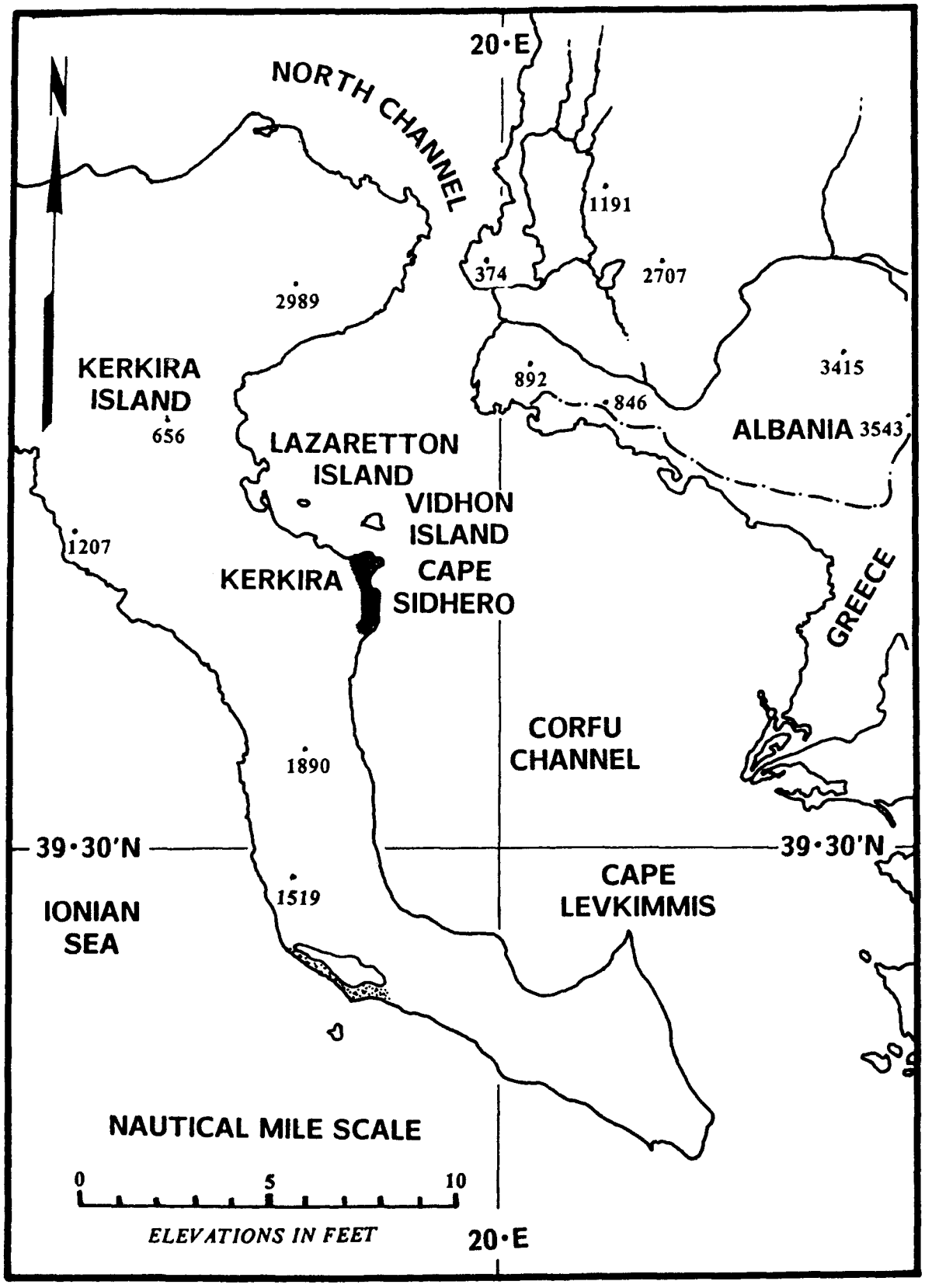

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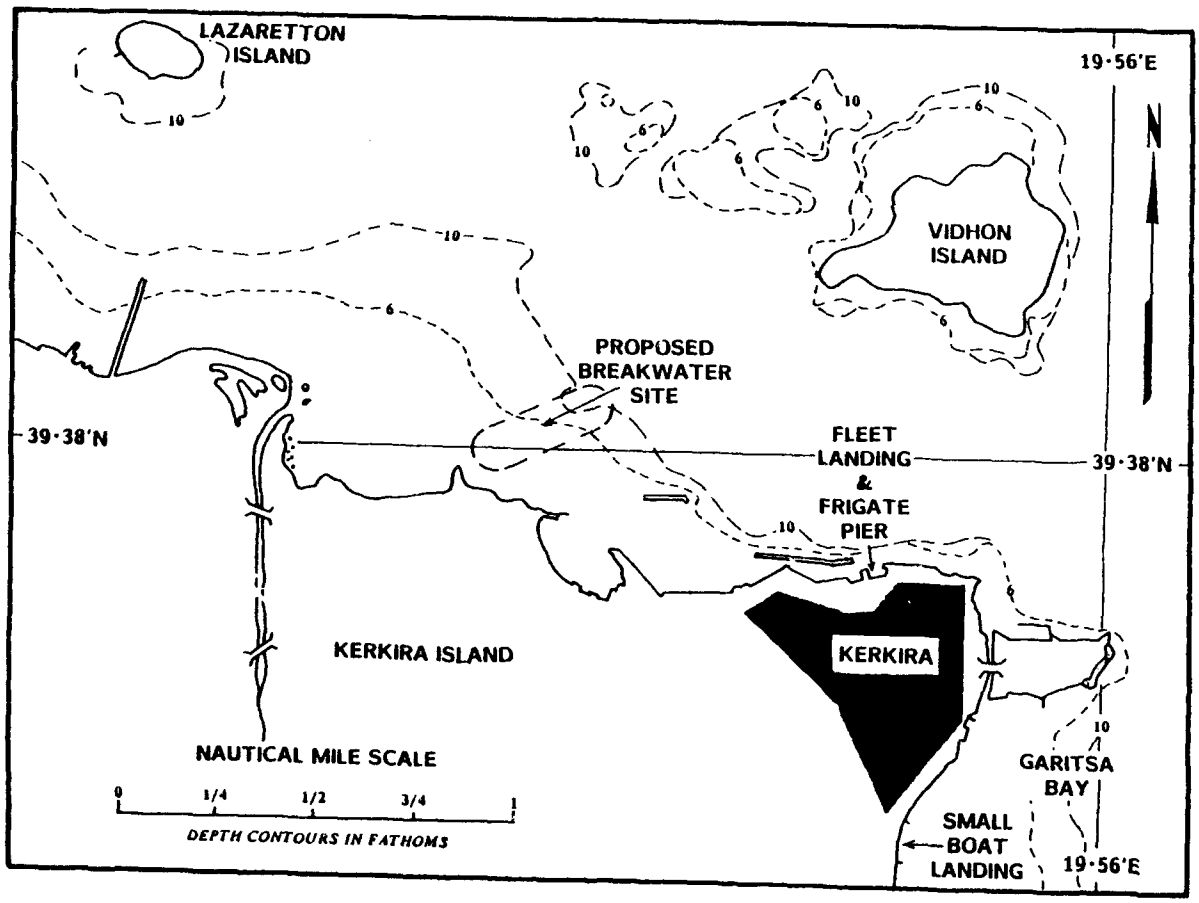

Figure 3-3. The Port of Kerkira (Corfu), Greece.

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Anchorage can be made between the harbor and Vidhon Island at depths of approximately 98 ft (39 m) with a stiff mud and clay bottom. Carriers typically anchor eastward of a north-south line from Cape Sidhero to Vidhon Island in 130 to 140 ft depths. This area has a mud bottom which provides poor holding. Caution was advised (Port Visit, 1990) relative to anchor dragging when southerly winds of 22 to 33 kt or greater are expected. Secondary anchorages are located south of Cape Sidhero and north-northwest of Lazaretton Island. The anchorage south of Cape Sidhero in, and offshore from, Garitsa Bay provides protection from strong north-northwest winds. Depths are in excess of 66 ft (20 m) at about 1/2 n mi offshore. The anchorage north-northwest of Lazaretton Island provides protection from the strong southerly winds occasionally experienced during winter. Depths range from 60 to 95 ft (18 to 29 m).

3.2 Qualitative Evaluation of the Port of Kerkira

Kerkira is a well protected port. No ship has ever been forced to leave due to weather (Port Visit, 1990). There have been no grounding incidents in the last 40 years. Strong northwesterly winds and waves may hamper or at times suspend cargo handling work and make berthing difficult (Hydrographer of the Navy, 1970). The primary anchorages are exposed but protected anchorages are located very nearby.

3.3 Currents and Tides

There are no reported significant current or tide activities in the harbor.

3.4 Visibility

Visibility is generally good, 8 to 10 miles. Occasional early morning fog during spring and summer reduces visibility to near zero with clearing by 1000 LST.

3.5 Hazardous Conditions

The Port of Kerkira and local anchorages are protected from the full force of open sea storms by the surrounding terrain.

The typical cause of the most hazardous conditions at Kerkira are associated with one of four general synoptic patterns: 1) cyclones approaching from the west (Genoa lows); 2) warm sector weather (Scirocco) in advance of North African depression systems; 3) cold season northerly winds (Bora) from off the Balkan Peninsula; and 4) summer northerly (Etesian) winds associated with the annual monsoonal pattern over southwestern Asia. As is the general case throughout the Mediterranean, the terrain of the Balkan Peninsula and other land areas, plus the numerous straits and narrows of the sea areas, have strong influences on local weather. In the case of Kerkira the local terrain influences are mostly protective in nature.

Although extremely rare, storms having tropical cyclone characteristics including apparent "eye" cloud configuration have been observed on at least three occasions in the Mediterranean Basin. During an event in September 1983 the storm moved from the Gulf of Gabes, through the Straits of Sicily, along the east coast of Sardinia and into the Gulf of Genoa. Winds of 60 kt

were reported at Cagliari, Sardinia while winds near the storm's eye were 100 kt.

A seasonal summary of various known environmental hazards that may be encountered in the Port of Kerkira follows.

A. Winter (November through February)

Even under the most severe weather, sortie to the open seas has not been required from the Port of Kerkira (Port Visit, 1990). The most hazardous conditions experienced at Kerkira are caused by winter migratory Genoa cyclones that either intensify or result in secondary development over the Ionian Sea, with the surface low then tracking northeastward and passing just to the west of Kerkira Island. The synoptic pattern favorable for events of this type evolve from a well-developed trough over Italy with favorable conditions for cyclogenesis in the Gulf of Genoa. Initial movement of the Genoa low must be to the southeast into the Ionian Sea, followed by recurvature to the northeast. The most intense of these systems result in southeasterly 41 to 47 kt (force 9) winds and waves of 6 to 7 ft over the Corfu Channel region. Vessels anchored outside of the eastern end of the roadstead between the town of Kerkira and Vidhon Island, in the carrier anchorage area, will experience the most hazardous conditions in the vicinity of the Port of Kerkira.

For those transiting lows that continue on an easterly course, generally passing south of Kerkira, the port area will first experience southeast-to-east winds followed by northerly winds as the low moves eastward. Throughout such cyclonic activity the wind speeds at Kerkira will be of the 22 to 33 kt (force 6-7) range or less. A complication of this type event results from the backing wind direction, southerly to easterly to northerly, with the resulting shift of location of most sheltered areas and anchorages from the harbor and north of Lazaretton

Island (under southerly winds) to the area south of Cape Sidhero in, or offshore from, Garitsa Bay (under northwesterly winds).

Scirocco events (cyclonic systems and southerly flow originating over North Africa) may also bring southerly winds of 22 to 33 kt (force 6-7) to the Kerkira area. (See Brody and Nestor (1980) for details on the Scirocco.) Sciroccos reaching the Kerkira area are of the moist type that bring clouds and precipitation that may contain dust. General Sciroccos are most frequent and intense during the spring period, but can occur any time of the year. For Scirocco conditions to reach the Kerkira area there must be a well-developed trough that extends out of Europe southward across the Mediterranean and over North Africa with the trough line in the vicinity of Italy.

The prevailing wind direction during winter is southeasterly. The land breeze off the cold, snow-covered mountains of the Balkan Peninsula is northerly. These opposing flows result in calm wind conditions about 40% of the time during the late night and morning periods, and about 25% of the time through the middle of the day (Hydrographer of the Navy, 1970). Variations from these calm or near calm conditions by either persistent southerly or northerly winds indicate some degree of disturbance from the normal daily circulation patterns.

Northerly (Bora) winds of 22 to 33 kt (force 6-7) may occur when either enhanced high pressure develops to the north over Europe or a cyclone passes eastward south of the local area. The most intense events will be experienced with some combination of the European high and transiting low occurring at the same time (NTAG Vol. III, 1980). The annual frequency of eastward tracking storms is highly variable, none occurred in the winter of 89-90, but as many as 10 have been experienced during other winters.

Below freezing temperatures can occur from November through early April (Hellenic NMS, 1990). On average, below freezing temperatures will occur about 4 days during January and 2 to 3 days in February. The coldest mornings range from about 23° to 26°F (-5° to -3°C). Because the northerly gradient flow and winter land breezes reenforce each other, northerly winds of 11 to 21 kt (force 4 to 5) are typical during the coldest mornings. A 20-kt wind at 25°F equates to an equivalent chill temperature of about -5°F/-21°C (Table 3-1).

Table 3-1. Wind Chill The cooling power of the wind expressed as "Equivalent Chill Temperature" (adapted from Kotsch, 1983).

Wind Speed		Cooling Power of Wind expressed as "Equivalent Chill Temperature"								
Knots	MPH	Temperature (°F)								
Calm	Calm	40	35	30	25	20	15	10	5	0
		Equivalent Chill Temperature								
3-6	5	35	30	25	20	15	10	5	0	-5
7-10	10	30	20	15	10	5	0	-10	-15	-20
11-15	15	25	15	10	0	-5	-10	-20	-25	-30
16-19	20	20	10	5	0	-10	-15	-25	-30	-35
20-23	25	15	10	0	-5	-15	-20	-30	-35	-45
24-28	30	10	5	0	-10	-20	-25	-30	-40	-50
29-32	35	10	5	-5	-10	-20	-30	-35	-40	-50
33-36	40	10	0	-5	-15	-20	-30	-35	-45	-55

B. Spring (March through May)

The transition from winter to summer is prolonged with alternating periods of winter- and summer-like conditions. Winter-like cyclonic storms should not be counted out until late May.

The frequency, intensity and extent of Scirocco conditions are at a maximum during spring. Scirocco events with south-to-southeasterly 22 to 33 kt winds and waves of 5 to 7 ft are likely to be experienced during spring. Scirocco conditions tend to

develop slowly over a day or two, but may persist for several days.

Early morning visibility of near zero in fog is likely to occur during periods when high pressure ridge lines extend southward out of Europe over the Kerkira area. Visibility generally improves by 1000 LST.

The prevailing winds remain southeasterly through spring but with a gradual weakening. Average cloud cover and precipitation amounts decrease quite rapidly through the period, but reflect the alternating winter/summer patterns on the daily-to-weekly basis.

C. Summer (June through September)

Typical Mediterranean climate dominates, nearly cloud and precipitation free with mild temperatures (daily highs in upper 80's, nightly lows in mid 60's). There are no truly hazardous weather conditions during summer. The prevailing winds become northerly in response to the development of the thermal low over southwestern Asia with relatively high pressure over the Mediterranean. A thermal low pressure trough extends westward along the southern coast of Turkey from the thermal low.

Enhanced northerly flow 11 to 21 kt (force 4-5) develops over the area when the thermal trough is most intense and/or shifted to its westerly most position off southwest Turkey. These events are called Meltemi in Kerkira and are part of the regional Etesian wind pattern which influences the Aegean Sea, Balkan Peninsula, and Asia Minor during summer. The Etesian is, in turn, a regional aspect of the continental scale monsoonal flow of Asia. Etesian events, and therefore Meltemis, tend to persist for two or three days. During these events the island sea-breeze may enhance the northerly flow and result in afternoon

winds of 17 to 21 kt (force 5) which can disturb routine harbor operations and small boat traffic.

While no local indicators were identified during the 1990 port visit to Kerkira the tendency for an increase in clouds the day before and first day of etesian events was noted as a well-known fact by Aegean Sea fishermen in Reiter (1971). During July and August the clouds are typically limited to scattered altocumulus on the day preceding the Etesian while thunderstorm activity over Greece tends to occur on the day before and first day of an Etesian during May-June and September-October periods.

D. Autumn (October)

The most hazardous aspect of weather in autumn, as elsewhere in the Mediterranean, is the rapidity with which the winter type pattern is established. On average the winter pattern is established around the end of the third week of October over the northern Mediterranean. While the first storms are not likely to be as intense as some later in the winter, the marked change from the summer Mediterranean weather can catch people unaware and unprepared. The migratory cyclones approaching from the west are the most likely events. Conditions for migratory lows are described in the Winter Section.

3.6 Harbor Protection

The port of Kerkira is a well protected port that has no recorded incidents of forced sorties due to severe weather nor any recorded anchor dragging incidents that resulted in groundings in the last 40 years (Port Visit, 1990).

3.6.1 Wind and Weather

The terrain features of Kerkira Island, the mainland, and the islands of Vidhon and Lazaretton provide some degree of protection from wind from all quadrants. Northerly winds are the most troublesome and can create hazardous cargo handling and

small boat operations. Southerly winds, preceding winter frontal passages, produce the strongest local winds. While the port area is well protected from southerly winds, the carrier anchorage area is exposed. Alongside operations are hazardous for ships at anchor under the strong northerly or southerly wind events. No other reports of hazardous weather except occasional morning fog during spring and summer and near freezing temperatures (wind chill) during winter northerly flow conditions have been identified during the review for this port.

3.6.2 Waves

The Port is well protected from all wave action. During northerly winds waves may reach 2-3 ft (1 m) in the harbor. Waves of 5-7 ft (1-2 m) are experienced at the carrier anchorage. Under the strongest northerly wind conditions experienced at the Port, wave and wind action in the harbor may necessitate canceling cargo handling in, and small boat and alongside operations outside, the harbor.

3.7 Protective and Mitigating Measures

3.7.1 Moving to a New Anchorage

When strong southerly winds are occurring the anchorage north of Lazaretton Island, or in the roadstead between the harbor and Vidhon Island, provide the best protection. During strong northwesterly winds protected anchorage can be found south of Cape Sidhero in, or offshore of, Garitsa Bay.

3.7.2 Scheduling

During winter periods of northerly wind events the strongest winds may occur during the morning period. The wind and waves may hinder alongside operations and small boat traffic at the anchorages plus cargo handling in the harbor. This condition results from the reenforcement of the northerly gradient flow by the land breeze off the snow-covered mountainous

areas of the Balkan Peninsula. In contrast, when the gradient wind is southerly, the northerly land breeze may offset it and near calm conditions will prevail during the morning.

During the summer the island sea breeze will reenforce the prevailing northerly flow during the afternoons. This results in wind and wave conditions that may hinder alongside operations and small boat traffic at the anchorages plus cargo handling in the harbor.

3.7.3 Fleet Landing Location

The normal fleet landing is located in the customs area just east of the easternmost breakwater (Port Visit, 1990). During strong wind/high wave conditions it can be relocated to one of three other locations: 1) west of the customs area inside the harbor; 2) east of the customs area in the northern end of the moat between the town and the citadel (FICEURLANT, 1987); or 3) during strong northerly winds to the central part of Garitsa Bay (Port Visit, 1990).

3.8 Local Indicators of Hazardous Weather Conditions

No local indicators were noted during the Port Visit of 1990. Reiter (1971) reported that increasing cloudiness over the Balkan Peninsula and Aegean Sea on the day preceding the establishment of an etesian wind period was a well-known fact by local fishermen. During the periods of May-June and September-October thunderstorms and lightning frequently occur on the day preceding the outbreak of the Etesian as well as on the first day of the Etesian. During July and August, when the most stable atmospheric conditions exist over the Mediterranean, scattered altocumulus are typically noted on the day preceding the onset of the Etesian.

Snow cover on the coastal mountains tends to enhance the land breeze. Therefore during winter, when the gradient flow is also northerly (Bora), the local northerly winds tend to be strongest in the morning period.

3.9 Summary of Problems, Actions, and Indicators

Table 3-2 is intended to provide easy-to-use seasonal references for forecasters or ships using the Port of Kerkira. Table 2-1 (Section 2) summarizes Table 3-2 and is intended primarily for use by ship captains.

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Table 3.2. Potential Problem Situations at

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIC
1. Anchored in - Roadstead or - Carrier Anchorage Most common in winter, can occur in spring and autumn. True African Sciroccos most common in spring	a. <u>SE-S'ly winds/wave</u>. - Generally referred to as "Sciroccos", but most often caused by cyclones and fronts approaching from the west. Occur during cold season, duration 1 to 2 days. Maximum winds, 41-47 kt (force 9), waves 4 to 7 ft (1-2 m).	a. Worst condition fo other exposed areas of anchorages can be found harbor and Vidhon Islan Lazaretton Island. Ver
Most frequent in summer, occurs all seasons.	b. <u>Northerly winds/wave</u>. - Locally called "Bora" during winter, "Meltemi" during summer. Winter "Bora", rapid onset, maximum winds, 34 to 40 kt (force 8), waves 3 to 5 ft (1-1½ m). Duration 1 to 2 days. Summer Meltemi/Etesian, 28-33 kt (force 7) waves 2 to 3 ft (1 m). Duration 2 to 4 days.	b. Worst condition for Protected anchorage sout Garitsa Bay for smaller offshore for carriers. protection in roadstead

ations at the Port of Kerkira, Greece -- All Seasons

:CAUTIONARY/EVASIVE ACTION	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARDS
tion for carrier anchorage and eas of Corfu Channel. Protected e found in roadstead between n Island or north to northwest of d. Very little effect in harbor.	a. Strong southerly winds, most often caused by cyclones and fronts approaching from the west, generally follow Genoa low development with intensification or secondary development in the Ionian Sea. True Siroccos result from development of African depressions, to reach Kerkira area must have 500 mb trough that extends from southern Europe across Mediterranean into North Africa. The onset of strong southerlies is gradual, typically occurring over a 12-to-24 hr period. Most rapid onset and strongest events will occur when systems approaching from the west intensify over the Ionian Sea.
tion for harbor and roadstead. age south of Cape Sidhero in smaller vessels or about ½ m riers. If winds are NE'ly some adstead in lee of Vidhon Island.	b. Strong northerlies can occur in either winter or summer. Winter events are associated with Boras and/or the northerly flow on the backside of cyclones tracking eastward, south of Kerkira. Frequency of eastward tracking storms is highly variable, none occurred in the winter of 89-90, but as many as 10 have been experienced in other winters. Both winter conditions, Boras and migratory lows, are associated with synoptic scale circulation patterns with primary development areas over southern Europe for Boras and over Italy for eastward tracking lows. Numerical guidance coupled with attention to synoptic scale conditions should provide 12-to-24 hr advance notice of these systems. Summer events are associated with Etesians. These periods of strongest northerly flow result from intensification of the thermal trough that extends westward from Asia Minor along the southern coast of Turkey. Increasing cloudiness develops over the Balkan Peninsula area the day before onset of an Etesian, generally alto-cumulus during July and August and thunderstorm activity during May-June and September-October periods.

Table 3.2 (continued)

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTION
2. Small Boats - Roadstead or - Carrier Anchorage Most common in winter, can occur in spring and autumn. True African Sciroccos most common in spring	a. SE-S'ly winds/wave. - Generally referred to as "Sciroccos", but most often caused by cyclones and fronts approaching from the west. Occur during cold season, duration 1 to 2 days. Maximum winds, 41-47 kt (force 9), waves 4 to 7 ft (1-2 m).	a. Small boat runs to/f would be hazardous. Flee to inner harbor area or t Vessels in carrier anchor age north-northwest of La result in 2 to 3 nm run t
Most frequent in summer, occurs all seasons.	b. Northerly winds/wave. - Locally called "Bora" during winter, "Meltemi" during summer. Winter "Bora", rapid onset, maximum winds, 34 to 40 kt (force 8), waves 3 to 5 ft (1-1½ m). Duration 1 to 2 days. Summer Meltemi/Etesian, 28-33 kt (force 7) waves 2 to 3 ft (1 m). Duration 2 to 4 days.	b. Small boat runs to/f er anchorage will be haza may be moved to inner har for traffic from vessels Sidhero. If winds are NE vides some protection for portion of roadstead. NE may be strongest from ear

RECAUTIONARY/EVASIVE ACTION	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARDS
t runs to/from carrier anchorage dous. Fleet landing may be moved r area or to north end of moat. rier anchorage may move to anchor- hwest of Lazaretton Island, will 3 nm run to fleet landings.	a. Strong southerly winds, most often caused by cyclones and fronts approaching from the west, generally follow Genoa low development with intensification or secondary development in the Ionian Sea. True Siroccos result from development of African depressions, to reach Kerkira area must have 500 mb trough that extends from southern Europe across Mediterranean into North Africa. The onset of strong southerlies is gradual, typically occurring over a 12-to-24 hr period. Most rapid onset and strongest events will occur when systems approaching from the west intensify over the Ionian Sea.
: runs to/from roadstead and carri- ill be hazardous. Fleet landing : inner harbor or in Garitsa Bay om vessels anchored south of Cape inds are NE'ly, Vidhon Island pro- ection for central and western istead. NE'ly winds during winter st from early morning to noon.	b. Strong northerlies can occur in either winter or summer. Winter events are associated with Boras and/or the northerly flow on the backside of cyclones tracking eastward, south of Kerkira. Frequency of eastward tracking storms is highly variable, none occurred in the winter of 89-90, but as many as 10 have been experienced in other winters. Both winter conditions, Boras and migratory lows, are associated with synoptic scale circulation patterns with primary development areas over southern Europe for Boras and over Italy for eastward tracking lows. Numerical guidance coupled with attention to synoptic scale conditions should provide 12-to-24 hr advance notice of these systems. Summer events are associated with Etesians. These periods of strongest northerly flow result from intensification of the thermal trough that extends westward from Asia Minor along the southern coast of Turkey. Increasing cloudiness develops over the Balkan Peninsula area the day before onset of an Etesian, generally alto-cumulus during July and August and thunderstorm activity during May-June and September-October periods.

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*Now Naval Research Laboratory, Monterey, CA 93943-5006.

Port Visit Information

May 1990: NOARL Meteorologists R. Fett and R. Miller met with the Harbor Master, Senior Commander S. Lomas and Lieutenant Commander M. Vlachos, to obtain much of the information included in this port evaluation.

APPENDIX A

General Purpose Oceanographic Information

This section provides some general definitions regarding waves and is extracted from H.O. Pub. No. 603, Practical Methods for Observing and Forecasting Ocean Waves (Pierson, Neumann, and James, 1955).

Definitions

Waves that are being generated by local winds are called "SEA". WAVES that have traveled out of the generating area are known as "SWELL". Seas are chaotic in period, height and direction while swell approaches a simple sine wave pattern as its distance from the generating area increases. An in-between state exists for a few hundred miles outside the generating area and is a condition that reflects parts of both of the above definitions. In the Mediterranean area, because its fetches and open sea expanses are limited, SEA or IN-BETWEEN conditions will prevail. The "SIGNIFICANT WAVE HEIGHT" is defined as the average value of the heights of the one-third highest waves. PERIOD and WAVE LENGTH refer to the time between passage of, and distances between, two successive crests on the sea surface. The FREQUENCY is the reciprocal of the period ($f = 1/T$); therefore as the period increases the frequency decreases. Waves result from the transfer of energy from the wind to the sea surface. The area over which the wind blows is known as the FETCH, and the length of time that the wind has blown is the DURATION. The characteristics of waves (height, length, and period) depend on the duration, fetch, and velocity of the wind. There is a continuous generation of small short waves from the time the wind starts until it stops. With continual transfer of energy from the wind to the sea surface the waves grow with the older waves leading the growth and spreading the energy over a greater range of frequencies. Throughout the growth cycle a SPECTRUM of ocean waves is being developed.

A Beaufort Scale table with related wave effects is shown on the following page.

BEAUFORT SCALE

Beaufort Number	Wind Speed Knots	Wind Speed MPH	Seaman's term	Effects observed at sea	Term and height of Waves in meters
0	Under 1	Under 1	Calm	Sea like mirror.	Calm, glassy, 0
1	1-3	1-3	Light air	Ripples with appearance of scales; no foam crests.	
2	4-6	4-7	Light breeze	Small wavelets; crests of glassy appearance, not breaking	Rippled, less than 0.5
3	7-10	8-12	Gentle breeze	Large wavelets; crests begin to break; scattered whitecaps.	Smooth, 0.5
4	11-16	13-18	Moderate breeze	Small waves, becoming longer; numerous whitecaps.	Slight, 1.0
5	17-21	19-24	Fresh breeze	Moderate waves, taking longer form; many whitecaps; some spray.	Moderate, 1.0-2.5
6	22-27	25-31	Strong breeze	Larger waves forming; whitecaps everywhere; more spray.	Rough, 2.5-4.0
7	28-33	32-38	Moderate gale	Sea heaps up; white foam from breaking waves begins to be blown up in streaks.	
8	34-40	39-46	Fresh gale	Moderate high waves; edges of crests begin to break; foam is blown in steaks.	Very rough, 4.0-6.0
9	41-47	47-54	Strong gale	High waves; sea begins to roll; dense streaks of foam; spray may reduce visibility.	
10	48-55	55-63	Whole gale	Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility reduced.	High, 6.0-9.0
11	56-63	64-72	Storm	Exceptionally high waves; sea covered with white foam patches; visibility still more reduced.	Very high, 9.0-13.5
12 13 14 15 16 17	64-71 72-80 81-89 90-99 100-108 109-118	73-82 83-92 93-103 104-114 115-125 126-136	Hurricane	Air filled with foam; sea completely white with driving spray; visibility greatly reduced. Winds of force 12 and above very rarely experienced on land; usually accompanied by widespread damage.	Phenomenal, greater than 13.5

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29F1	Guided Missile Destroyer LANT
29G1	Guided Missile Frigate (LANT)
29I1	Frigate LANT (FF 1098)
29J1	Frigate LANT (FF 1040/1051 Class)
29K1	Frigate LANT (FF 1052/1077 Class)
29L1	Frigate LANT (FF 1078/1097 Class)
29N1	Submarine LANT (SSN)
29Q	Submarine LANT SSBN
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This handbook for the port of Kerkira (Corfu), one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.

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